

GENERAL INFORMATION

The questions printed herein are representative of the scope of the questions contained in the various elements of the commercial radio operator examination.

Element 1 of the examination consists of 20 questions and 5 percent credit will be allowed for each question answered correctly. Elements 2, 4, 5 and 8 of the examination contain 50 questions each. Two percent credit will be allowed for each correct solution. Elements 3, 6 and 7 consist of 100 questions each and 1 percent credit will be allowed for each correct solution to these questions.

The 50 questions of Element 2 are subdivided so that a candidate who wishes to do so may, for 10 of the questions, select the subject to be dealt with from one of three fields, namely ship, coastal, or aircraft radiotelephony.

None of the questions in the commercial radio operator license examination requires an essay or explanatory type of answer. In answering the type of question in which several choices are given, the applicant *must* choose *one* (and only *one*) of the answers shown. The numeral preceding the answer which is selected as correct must be inserted in the space which is provided at the right-hand side of the question. Two examples of this type of question are given below:

965.07 Seattle is located in:

1. Nebraska.
2. New York.
3. Oregon.
4. Washington.
5. Texas.

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965.08 Seattle is *not* located in:

1. The Western Hemisphere.
2. The United States.
3. North America.
4. Washington.
5. Canada.

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The other types of questions which may be found in the examination are to be answered by the solution of a simple mathematical problem, the drawing of a diagram, the completion of an incomplete diagram, or the correction of an incorrect diagram, as required. In the correction of an incorrect diagram, any connection or symbol which is to be eliminated shall be crossed out by means of a wavy line or by short diagonal cross lines.

The applicant must sign his name in the space which is provided on each sheet of the examination. Before beginning the examination, the applicant should read carefully the instructions printed on the element envelope.

All paper for writing examinations will be furnished. Books or papers may not be taken into the examining room.

Additional information pertaining to the commercial radio operator examinations may be found in part 13 of the Commission's rules, published as a separate document and normally obtainable from the Superintendent of Documents, U. S. Printing Office, Washington 25, D. C.

Regulatory information commonly used in preparing for commercial radio operator examinations is to be found in appendix I, which contains extracts from the following:

Communications Act of 1934, as amended.

International Radio Regulations, Atlantic City, 1947.

International Telecommunication Convention, Atlantic City, 1947.

Telegraph Regulations (Paris Revision, 1949).

Civil Air Regulations.

International Civil Aviation Organization Publications.

Agreement Between the United States of America and Canada for Promotion of Safety on the Great Lakes by Means of Radio.

Rules and Regulations of the Federal Communications Commission.

Appendix II contains tables of abbreviations used in radio communications and the International Telegraph Code with punctuation symbols.

Appendix III contains material for use in preparing for Elements 2 and 5.

KEY TO ABBREVIATIONS

Sec. Refers to a section of the Communications Act of 1934.

Art. Refers to an article of the International Radio Regulations (Atlantic City 1947).

R. & R. Refers to a provision of the Rules and Regulations of the Federal Communications Commission.

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GLR Refers to regulations annexed to Agreement between the United States and Canada for Promotion of Safety on the Great Lakes by Means of Radio.

CAR Refers to Civil Air Regulations.

ICAO Refers to International Civil Aviation Organization Publications.

S. G. E. P. Standards of Good Engineering Practice.

T. R. Refers to the International Telegraph Regulations (Paris Revision, 1949).

Caveat: The revision of the Study Guide in which this caveat appears is based upon the Communications Act of 1934, as amended to May 16, 1955, and Commission Rules and Regulations and all treaty and convention provisions in force on that date.

61. What is the relationship between the number of turns and the inductance of a coil?
62. Define the term "reluctance".
63. State the formula for determining the resonant frequency of a circuit when the inductance and capacitance are known.
64. What is the formula for determining the power in a d. c. circuit when the voltage and resistance are known?
65. What is the formula for determining the power in a d. c. circuit when the current and resistance are known?
66. What is the formula for determining the power in a d. c. circuit when the current and voltage are known?
67. What is the formula for determining the wavelength when the frequency, in kilocycles, is known?
68. State Ohm's Law for a. c. circuits.
69. Draw a simple schematic diagram showing a tuned-plate tuned-grid oscillator with series-fed plate. Indicate polarity of supply voltages.
70. Draw a simple schematic diagram showing a Hartley triode oscillator with shunt-fed plate. Indicate power supply polarity.
71. Draw a simple schematic diagram showing a tuned-grid Armstrong type triode oscillator, with shunt-fed plate. Indicate power supply polarity.
72. Draw a simple schematic diagram showing a tuned-plate tuned-grid triode oscillator with shunt-fed plate. Indicate polarity of supply voltages.
73. Draw a simple schematic diagram of a crystal controlled vacuum tube oscillator. Indicate power supply polarity.
74. Draw a simple schematic diagram showing a Colpitts type triode oscillator, with shunt-fed plate. Indicate power supply polarity.
75. Draw a simple schematic diagram showing a tuned-grid Armstrong type triode oscillator, with series-fed plate. Indicate power supply polarity.
76. Draw a simple schematic diagram of an electron coupled oscillator, indicating power supply polarities where necessary.
77. Draw a simple schematic diagram of a pentode type tube used as a crystal controlled oscillator, indicating power supply polarities.
78. Draw a simple schematic circuit showing a method of coupling a high impedance loudspeaker to an audio-frequency amplifier tube without flow of tube plate current through the speaker windings, and without the use of a transformer.

79. Draw a simple schematic diagram of a triode vacuum tube audio frequency amplifier inductively coupled to a loudspeaker.
80. Draw a simple schematic circuit showing a method of resistance coupling between two triode vacuum tubes in an audio frequency amplifier.
81. Draw a simple schematic diagram showing a method of transformer coupling between two triode vacuum tubes in an audio frequency amplifier.
82. Draw a simple schematic diagram of a method of impedance coupling between two vacuum tubes in an audio frequency amplifier.
83. Draw a simple schematic diagram showing a method of coupling the radio frequency output of the final power amplifier stage of a transmitter to an antenna.
84. Draw a simple schematic diagram showing a method of coupling between two tetrode vacuum tubes in a tuned radio frequency amplifier.
85. Draw a simple schematic diagram showing a method of coupling between two triode vacuum tubes in a tuned radio frequency amplifier, and a method of neutralizing to prevent oscillation.
86. Draw a simple schematic diagram of a diode vacuum tube connected for diode detection, and showing a method of coupling to an audio amplifier.
87. Draw a simple schematic diagram of a triode vacuum tube connected for plate or "power" detection.
88. Draw a simple schematic diagram of a triode vacuum tube connected for grid-leak condenser detection.
89. Draw a simple schematic circuit of a regenerative detector.
90. Draw a simple schematic circuit of a radio frequency doubler stage, indicating any pertinent points which will distinguish this circuit as that of a frequency doubler.
91. Draw a simple schematic diagram showing the method of connecting three resistors of equal value so that the total resistance will be two-thirds the resistance of one unit.
92. Draw a simple schematic diagram showing the method of connecting three resistors of equal value so that the total resistance will be one and one-half times the resistance of one unit.
93. Draw a simple schematic diagram showing the method of connecting three resistors of equal value so that the total resistance will be one-third of one unit.
94. Draw a simple schematic diagram showing the method of connecting three resistors of equal value so that the total resistance will be three times the resistance of one unit.

95. Draw a diagram of a single-button carbon microphone circuit, including the microphone transformer and source of power.
96. What is meant by a "soft" vacuum tube?
97. Describe the electrical characteristics of the pentode, tetrode, and triode.
98. What are the visible indications of a "soft" tube?
99. Describe the physical structure of a triode vacuum tube.
100. Describe the physical structure of a tetrode vacuum tube.
101. Does a pentode vacuum tube usually require neutralization when used as a radio-frequency amplifier?
102. What is the meaning of "secondary emission"?
103. What is the meaning of "electron emission"?
104. Describe the characteristics of a vacuum tube operating as a class C amplifier.
105. During what approximate portion of the excitation voltage cycle does plate current flow when a tube is used as a class C amplifier?
106. Describe the characteristics of a vacuum tube operating as a class A amplifier.
107. Describe the characteristics of a vacuum tube operating as a class B amplifier.
108. During what portion of the excitation voltage cycle does plate current flow when a tube is used as a class B amplifier?
109. Does a properly operated class A audio amplifier produce serious modification of the input wave form?
110. What is the meaning of the term "maximum plate dissipation"?
111. What is meant by a "blocked grid"?
112. What is meant by the "load" on a vacuum tube?
113. What circuit and vacuum tube factors influence the voltage gain of a triode audio frequency amplifier stage?
114. What is the purpose of a bias voltage on the grid of an audio frequency amplifier tube?
115. What is the primary purpose of a screen grid in a vacuum tube?
116. What is the primary purpose of a suppressor grid in a multi-element vacuum tube?
117. What is the meaning of the term "plate saturation"?
118. What is the most desirable factor in the choice of a vacuum tube to be used as a voltage amplifier?
119. What is the principal advantage of a tetrode over a triode as a radio-frequency amplifier?
120. What is the principal advantage of the tetrode as compared to the triode, when used in a radio receiver?

121. What is the principal advantage in the use of a diode detector instead of a grid-leak type triode detector?
122. Draw a grid voltage-plate current characteristic curve of a vacuum tube and indicate the operating points for class A, class B, and class C amplifier operation.
123. What operating conditions determine that a tube is being used as a "power detector"?
124. Why is it desirable to use an alternating current filament supply for vacuum tubes?
125. Why is it advisable to reverse periodically the polarity of the filament potential of high power vacuum tubes when a d. c. filament supply is used?
126. Why is it important to maintain transmitting tube filaments at recommended voltages?
127. When an alternating current filament supply is used, why is a filament center-tap usually provided for the vacuum tube plate and grid return circuits?
128. Explain the operation of a "grid leak" type detector.
129. List and explain the characteristics of a "square law" type of vacuum tube detector.
130. Explain the operation of a diode type of detector.
131. Explain the operation of a "power" or "plate rectification" type of vacuum tube detector.
132. Is a "grid leak" type of detector more or less sensitive than a "power" detector (plate rectification)? Why?
133. Describe what is meant by a "class A amplifier."
134. What are the characteristics of a class A audio amplifier?
135. What will be the effect of incorrect grid bias in a class A audio amplifier?
136. What are the factors which determine the bias voltage for the grid of a vacuum tube?
137. Why are tubes, operated as class C amplifiers, not suited for audio frequency amplification?
138. Draw a circuit of a "frequency doubler" and explain its operation.
139. For what purpose is a "doubler" amplifier stage used?
140. Describe what is meant by "link coupling" and for what purpose(s) is it used?
141. What factors may cause low plate current in a vacuum tube amplifier?
142. Given the following vacuum tube constants $E_p = 1,000$ volts, $I_P = 150$ ma., $I_g = 10$ ma., and grid leak $5,000$ ohms, what would be the value of d. c. grid bias voltage?
143. Explain how you would determine the value of cathode

276. Explain the operation of a triode vacuum tube as an amplifier.

277. What is the approximate efficiency of a class A vacuum tube amplifier? Class B? Class C?

278. Does d. c. grid current normally flow in a class A amplifier employing one tube?

279. Why must some radio frequency amplifiers be neutralized?

280. Describe how a vacuum tube oscillates in a circuit?

281. Is the d. c. bias normally positive or negative in a class A amplifier?

282. What is the composition of filaments, heaters and cathodes in vacuum tubes?

283. What is the direction of electronic flow in the plate and grid circuits of vacuum tube amplifiers?

284. Draw a diagram showing a method of obtaining grid bias to an indirectly heated cathode type vacuum tube by use of a resistance in the cathode circuit of the tube.

285. Draw a diagram showing a method of obtaining grid bias to a filament type vacuum tube by use of a resistance in the plate circuit of the tube.

286. What is the impedance of a solenoid if its resistance is 5 ohms and 0.3 amperes flow through the winding when 110 volts at 60 cycles is applied to the solenoid?

287. What is the conductance of a circuit if 6 amperes flow when 12 volts d. c. is applied to the circuit?

288. What is the relationship between the effective value of a radio frequency current and the heating value of the current?

289. What safety precautions should a person observe when making internal adjustments to a television receiver to avoid personal injury?

290. With measuring equipment that is widely available, is it possible to measure a frequency of 10,000,000 cycles to within one cycle of the exact frequency?

291. Do oscillators operating on adjacent frequencies have a tendency to synchronize oscillation or drift apart in frequency?

292. What form of energy is stored in lead type storage batteries?

293. What precaution should be observed when using and storing crystal microphones?

294. If a 1,500 kilocycle radio wave is modulated by a 2,000 cycle sine wave tone, what frequencies are contained in the modulated wave?

295. Why are laminated iron cores used in audio and power transformers?

296. What are cathode rays?

297. Why is a high ratio of capacity to inductance employed in the grid circuit of some oscillators?

298. What is the purpose of a buffer amplifier stage in a transmitter?

299. What determines the speed of a synchronous motor? An induction motor? A d. c. series motor?

300. What is the total resistance of a parallel circuit consisting of one branch of 10 ohms resistance and one branch of 25 ohms resistance?

301. Draw a diagram of a resistance load connected in the plate circuit of a vacuum tube and indicate the direction of electronic flow in this load.

302. Indicate by a drawing a sine wave of voltage displaced 180 degrees from a sine wave of current.

303. Show by a diagram how a voltmeter and ammeter should be connected to measure power in a d. c. circuit.

304. Indicate by a diagram how the total current in three branches of a parallel circuit can be measured by one ammeter.

305. Draw a graph indicating how the plate current in a vacuum tube varies with plate voltage, grid bias remaining constant.

306. Indicate by a drawing two cycles of a radio frequency wave and indicate one wave length thereof.

307. Explain the purposes and methods of neutralization in radio-frequency amplifiers.

308. In a circuit consisting of an inductance having a reactance value of 100 ohms and a resistance of 100 ohms, what will be the phase angle of the current with reference to the voltage?

309. What is the effective value of a sine wave in relation to its peak value?

310. What is the meaning of "phase difference"?

311. What factors must be known in order to determine the power factor of an alternating current circuit?

312. What are the properties of a series condenser, acting alone in an a. c. circuit?

313. What is the reactance value of a condenser of 0.005 microfarad at a frequency of 1000 kilocycles?

314. State the mathematical formula for the energy stored in the magnetic field surrounding an inductance carrying an electric current.

315. What is the current and voltage relationship when inductive reactance predominates in an a. c. circuit?

316. Given a series circuit consisting of a resistance of 4 ohms,

120. What is the ratio of peak to average values of a sine wave? Peak to effective voltage values of a sine wave?

121. Draw diagrams showing various ways by which three power transformers can be connected for operation on a three-phase circuit. Show how only two transformers can be connected for full operation on a three-phase circuit.

122. Define the term "reluctance".

123. Define the term "permeability".

124. What is the meaning of "residual magnetism"?

125. Which factors influence the direction of magnetic lines of force generated by an electromagnet?

126. What is the effect of adding an iron core to an air core inductance?

127. Name at least five pieces of radio equipment which make use of electromagnets.

128. Neglecting temperature coefficient of resistance and using the same gauge of wire and the same applied voltage in each case, what would be the effect upon the field strength of a single layer solenoid of a small increase in the number of turns?

129. Why may a transformer not be used with direct current?

130. Describe the physical structure of a triode vacuum tube.

131. Describe the physical structure of a tetrode vacuum tube.

132. Describe the physical structure of the triode, tetrode, and pentode vacuum tubes on a comparative basis.

133. Describe the electrical characteristics of the pentode, tetrode and triode vacuum tubes on a comparative basis.

134. Define the following terms in reference to vacuum tubes: Amplification factor, plate resistance, mutual conductance, and maximum inverse plate voltage.

135. What is the primary purpose of the control grid of a triode?

136. What is the primary purpose of the screen grid of a tetrode?

137. What is the primary purpose of the suppressor grid of a pentode tube?

138. What is the composition of filaments, heaters and cathodes in vacuum tubes?

139. Describe the construction of a "beam power" vacuum tube. In what types of circuits do these tubes find application?

140. What is the meaning of "electron emission"?

141. What is the meaning of "secondary emission"?

142. Describe the characteristics of a vacuum tube operating as a class A amplifier.

143. Describe the characteristics of a vacuum tube operating as a class B amplifier.

144. What are the factors which determine the bias voltage for the grid of a vacuum tube?

145. Draw a grid voltage-plate current characteristic curve of a vacuum tube and indicate the operating points for class A, class B, and class C amplifier operation.

146. Explain the operation of a triode vacuum tube as an amplifier.

147. Does d. c. grid current normally flow in a class A amplifier employing one tube?

148. Is the d. c. bias normally positive or negative in a class A amplifier?

149. What will be the effect of incorrect grid bias in a class A audio amplifier?

150. What is the approximate efficiency of a class A vacuum tube amplifier? Class B? Class C?

151. What is "space charge" in a vacuum tube?

152. What is a "getter" in a vacuum tube?

153. What types of vacuum tube emitting surfaces respond to reactivation?

154. Describe how reactivation may be accomplished.

155. Is a tungsten filament operated at higher or lower temperatures than a thoriated filament? Why?

156. What is indicated when a blue glow is noticed within a vacuum tube envelope?

157. Why should the cathode of an indirectly heated type of vacuum tube be maintained at nearly the same potential as the heater circuit?

158. Why is it important to maintain transmitting tube filaments at recommended voltages?

159. Why is it desirable to use an alternating current filament supply for vacuum tubes?

160. Why is it advisable to periodically reverse the polarity of the filament potential of high power vacuum tubes when a d. c. filament supply is used?

161. What is the purpose of a bias voltage on the grid of an audio frequency amplifier tube?

162. What is the primary purpose of a screen grid in a vacuum tube?

163. What is the primary purpose of a suppressor grid in a multi-element vacuum tube?

164. What circuit and vacuum tube factors influence the voltage gain of a triode audio frequency amplifier stage?

165. What is meant by the "load" on a vacuum tube?
166. What is meant by a "blocked grid"?
167. What is the meaning of the term "maximum plate dissipation"?
168. What is the meaning of the term "plate saturation"?
169. What is the most desirable factor in the choice of a vacuum tube to be used as a voltage amplifier?
170. What is the principal advantage of a tetrode over a triode as a radio-frequency amplifier?
171. Describe the characteristics of a vacuum tube operating as a class C amplifier.
172. During what approximate portion of the excitation voltage cycle does plate current flow when a tube is used as a class C amplifier?
173. What is meant by a "soft" vacuum tube?
174. Why are tubes, operated as class C amplifiers, not suited for audio frequency amplification?
175. What factors may cause low plate current in a vacuum tube amplifier?
176. Describe how a vacuum tube oscillates in a circuit?
177. Why must some radio frequency amplifiers be neutralized?
178. What are cavity resonators and in what type of radio circuits do they find application?
179. What determines the operating frequency of a magnetron oscillator? A klystron oscillator?
180. In what radio circuits do klystron and magnetron oscillators find application?
181. Explain the operation of a diode type of detector.
182. Explain the operation of a "grid leak" type detector.
183. What effect does an incoming signal have upon the plate current of a triode detector of the grid-leak type?
184. List and explain the characteristics of a "square law" type of vacuum tube detector.
185. Is a "grid leak" type of detector more or less sensitive than a "power" detector (plate rectification)? Why?
186. What is the principal advantage in the use of a diode detector instead of a grid-leak type triode detector?
187. What operating conditions determine that a tube is being used as a "power detector"?
188. When an alternating current filament supply is used, why is a filament center-tap usually provided for the vacuum tube plate and grid return circuits?
189. Explain how you would determine the value of cathode

bias resistance necessary to provide correct grid bias for any particular amplifier.

190. Given the following vacuum tube constants. E_p - 1,000 volts, I_p - 150 ma., I_g - 10 ma., and grid leak - 5,000 ohms, what would be the value of d. c. grid bias voltage?

191. A triode transmitting tube, operating with plate voltage of 1,250 volts, has filament voltage of 10, filament current of 3.25 amperes and plate current of 150 milliamperes. The amplification factor is 25. What value of control grid bias must be used for operation as a class C stage?

192. What currents will be indicated by a milliammeter connected between the center tap of the filament transformer of a tetrode, and negative high voltage (ground)?

193. What is a dynatron oscillator? Explain its principle of operation.

194. What is an electron-coupled oscillator? Explain its principle of operation.

195. Name four materials which can be used as "crystal" detectors.

196. Explain the operation of a "power" or "plate rectification" type of vacuum tube detector.

197. For what purpose is a "doubler" amplifier stage used? Draw the circuit and explain its operation.

198. Does a pentode vacuum tube usually require neutralization when used as a radio-frequency amplifier?

199. What is the function of a quartz crystal in a radio transmitter?

200. Name four advantages of crystal control over tuned circuit oscillators.

201. Why is the temperature of a quartz crystal usually maintained constant? What does the expression "a low temperature coefficient crystal" mean?

202. Why is a separate source of power sometimes desirable for the crystal oscillator unit of a transmitter?

203. What does the statement "the temperature coefficient of an X-cut crystal is negative" mean?

204. What will be the effect of applying a d. c. potential to the opposite plane surfaces of a quartz crystal?

205. What does the statement "the temperature coefficient of a Y-cut crystal is positive" mean?

206. What is a thermocouple?

207. What are wave guides and in what type of radio circuits do they find application?

363. When filter condensers are connected in series, resistors of high value are often connected across the terminals of the individual condensers. What is the purpose of this arrangement?

364. What is a desirable feature of an electrolytic condenser as compared to other types?

365. Indicate the approximate values of power supply filter inductances encountered in practice.

366. A radio receiver has a power transformer and rectifier designed to supply plate voltage to the vacuum tubes at 250 volts when operating from a 110-volt 60-cycle supply. What will be the effect if this transformer primary is connected to a 110-volt d. c. source?

367. Describe the action and list the main characteristics of a shunt wound d. c. motor.

368. Describe the action and list the main characteristics of a series wound d. c. motor.

369. What is meant by "counter emf" in a d. c. motor?

370. Explain the principle of operation and list the main characteristics of a compound wound d. c. motor and explain how the speed is regulated.

371. Why is laminated iron or steel generally used in the construction of the field and armature cores of motors and generators instead of solid metal?

372. What is the purpose of a commutator on a d. c. motor? On a d. c. generator?

373. Why is a series motor not used in radio power supply motor-generators?

374. What is the danger of operating a d. c. series motor without a load?

375. If the field of a shunt-wound d. c. motor were opened while the machine was running under no load, what would be the probable result(s)?

376. What is the purpose of "commutating poles" or "interpoles" in a d. c. motor?

377. What will be the effect(s) of a short circuit in an armature coil of a d. c. motor?

378. When starting a large d. c. motor-generator set what adjustment should be made to the motor field rheostat?

379. What may be the trouble if a motor generator fails to start when the start button is depressed?

380. Explain the principle of operation and list the main operating characteristics of a d. c. shunt generator and a d. c. compound generator. Explain how the voltage of a d. c. gen-

erator can be controlled. Draw a simple schematic circuit diagram of each of these types of generators.

381. Describe the action and list the main characteristics of a series wound d. c. generator.

382. When increased output voltage is desired from a motor-generator set, what is the usual procedure?

383. Describe the construction of a dynamotor. What are its operating characteristics?

384. How may the output voltage of a dynamotor be regulated?

385. What is the principal advantage in the use of a dynamotor, rather than a motor generator, to furnish plate power to a small mobile transmitter? Principal disadvantage?

386. Name four causes of excessive sparking at the brushes of a d. c. motor or generator.

387. Why are bypass condensers often connected across the brushes of a high voltage d. c. generator?

388. What may cause a motor-generator bearing to overheat?

389. How may the radio-frequency interference, often caused by sparking at the brushes of a high-voltage generator, be minimized?

390. Why should emery cloth never be used to clean the commutator of a motor or generator?

391. If a 3-horsepower, 110-volt d. c. motor is 85 percent efficient when developing its rated output, what will be the line current?

392. Explain the principle of operation of an induction motor and how such motors are started.

393. What determines the speed of a synchronous motor? An induction motor? A d. c. series motor?

394. What is the line current of a single-phase, 7-horsepower a. c. motor when operating from a 120-volt line at full rated load and at a power factor of 0.8 and 95 percent efficiency.

395. In what units is an alternator output ordinarily rated?

396. What conditions must be met before two a. c. generators can be operated in parallel?

397. What is the effect of an inductive load on the output voltage of an alternator?

398. Draw a simple schematic circuit diagram of three kinds of d. c. motors, including a starting device.

399. Draw a simple schematic diagram showing a Colpitts-type triode oscillator, with shunt-fed plate. Indicate power supply polarity.

400. Draw a simple schematic diagram of an electron coupled oscillator, indicating power supply polarities where necessary.

401. Draw a simple schematic diagram showing a Hartley triode oscillator with shunt-fed plate. Indicate power supply polarity.

402. Draw a simple schematic diagram showing a tuned-grid Armstrong-type triode oscillator with shunt-fed plate. Indicate power supply polarity.

403. Draw a simple schematic diagram showing a tuned-plate tuned-grid triode oscillator with shunt-fed plate. Indicate polarity of supply voltages.

404. Draw a simple schematic diagram of a crystal-controlled triode vacuum tube oscillator. Indicate power supply polarity.

405. Draw a simple schematic diagram of a pentode-type tube used as a crystal-controlled oscillator, indicating power supply polarities.

406. Draw a simple schematic diagram showing a tuned-plate tuned-grid oscillator with series-fed plate. Indicate polarity of supply voltages.

407. Draw a simple schematic diagram of a crystal-controlled vacuum tube oscillator using a tetrode-type tube. Indicate power supply polarity where necessary.

408. What will be the effect of a high degree of coupling between the plate and grid circuits of a quartz crystal oscillator?

409. Draw a simple schematic diagram of a crystal-controlled oscillator and means of coupling to the following radio-frequency amplifier stage, showing power supply polarities.

410. What type of oscillator depends upon secondary emission from the anode for its operation?

411. Draw a simple schematic diagram of a dynatron oscillator using a tetrode, indicating polarity of power supply voltages.

412. Why is an additional plate-grid feedback condenser sometimes necessary in a crystal oscillator?

413. Draw a simple schematic diagram of a Pierce oscillator.

414. What is the principal advantage to be gained by the use of a crystal-controlled oscillator in a marine radiotelegraph transmitter?

415. Discuss the advantages and disadvantages of self-excited oscillator and master oscillator-power amplifier transmitters.

416. What is the primary function of the power amplifier stage of a marine radiotelegraph transmitter?

417. What is the purpose of a buffer amplifier stage in a transmitter?

418. Draw a simple schematic diagram showing a method of coupling the radio frequency output of the final power amplifier stage of a transmitter to an antenna.

419. What class of amplifier should be employed in the final amplifier stage of a radiotelegraph transmitter for maximum plate efficiency?

420. Under what "class" of amplification are the vacuum tubes in a linear radio-frequency amplifier stage, following a modulated stage, operated?

421. If a final radio-frequency amplifier, operated as class B linear, were excited to saturation with no modulation, what would be the effects when undergoing modulation?

422. Define a class C amplifier.

423. Discuss the effects of insufficient radio-frequency excitation on a class C modulated radio-frequency amplifier insofar as the output signal wave form is concerned.

424. What is the second harmonic of 380 kilocycles?

425. What are the effects of overexcitation of a class B amplifier grid circuit?

426. What is the function of a grid leak in a class C amplifier?

427. Describe how a radio-frequency amplifier stage may be neutralized. What precautions must be observed.

428. Why is a "speech amplifier" used in connection with the modulator of a radiotelephone transmitter?

429. If the first speech amplifier tube of a radiotelephone transmitter were overexcited, but the percentage modulation capabilities of the transmitter were not exceeded, what would be the effect upon the output?

430. How should the bias of a grid modulated radio frequency stage be adjusted?

431. Compare the characteristics of plate and grid bias modulation.

432. What is meant by "low level" modulation?

433. Should the efficiency of a grid bias modulated stage be maximum at complete modulation or zero modulation? Explain.

434. Does grid current flow in the conventional grid bias modulated stage of a radiotelephone transmitter, under modulated conditions?

435. What might be the causes of a positive shift in carrier amplitude during modulation?

436. What is the ratio between the d. c. power input of the plate circuit of the stage being plate modulated, and the output audio power of the modulator for 100-percent sinusoidal modulation?

437. What increase in antenna current will be observed when a radiotelephone transmitter is modulated 100 percent by a sinusoidal wave form?

530. Why do many marine transmitters employ variometers rather than variable condensers as the tuning elements?

531. What is the relationship between the antenna current and radiated power of an antenna?

532. What is the purpose of the iron compound cylinders which are found in the inductances of certain marine radiotelegraph transmitters? The position of these cylinders, with respect to the inductances, is adjustable for what purpose?

533. What is the meaning of "high level" modulation?

534. Draw a block diagram of a superheterodyne receiver capable of receiving continuous wave radiotelegraph signals.

535. Draw a block diagram of superheterodyne receiver designed for reception of FM signals.

536. Draw a block diagram of a tuned radio-frequency type receiver.

537. Describe the principle of operation of a "super regenerative" receiver.

538. What is the purpose of a tuned radio-frequency amplifier stage ahead of the mixer stage of a superheterodyne receiver?

539. What is the "mixer" tube in the superheterodyne receiver?

540. Knowing the intermediate frequency and the signal to which a superheterodyne receiver is tuned, how would you determine the most probable frequency on which "image" reception would occur?

541. A superheterodyne-type receiver is adjusted to 2738 kilocycles. The intermediate frequency is 475 kilocycles; what is the frequency to which the grid circuit of the second detector must be tuned?

542. Explain the reasons why a superheterodyne receiver may not be successfully used for reception of frequencies very near the frequency of the intermediate frequency amplifier.

543. Why do some superheterodyne receivers employ a crystal-controlled oscillator in the first detector?

544. How should a superheterodyne communications receiver be adjusted for maximum response to weak CW signals? To strong CW signals?

545. Why should a superheterodyne receiver, used for the reception of A-1 signals, be equipped with at least one stage of radio-frequency amplification ahead of the first detector?

546. What is the chief advantage to be gained in the utilization of high intermediate frequencies in a superheterodyne receiver?

547. If a superheterodyne receiver is receiving a signal on

1000 kilocycles, and the mixing oscillator is tuned to 1500 kilocycles, what is the intermediate frequency?

548. How may "image response" be minimized in a superheterodyne receiver?

549. In a tuned radio frequency receiver, what is the advantage of heterodyne reception as compared to autodyne reception?

550. Describe the operation of a regenerative-type receiver.

551. Discuss the relative advantages and disadvantages of a stage of radio-frequency amplification as compared to a stage of audio-frequency amplification for use in connection with regenerative receiver?

552. What controls determine the selectivity of a 3-circuit receiver?

553. What are the objections to the operation of a regenerative, oscillating detector receiver, when directly coupled to an antenna?

554. If a ship's regenerative receiver failed to oscillate when the regeneration control was advanced, explain the possible causes and remedies.

555. Explain how you would test the various components of a receiver of the 3-circuit regenerative-type in "trouble shooting".

556. What may be the cause of noisy operation of a regenerative, 3-circuit receiver, having 2 stages of audio-frequency amplification?

557. Describe how you could test a regenerative receiver to determine if the detector is in an oscillating condition.

558. Using a regenerative receiver, without radio-frequency amplifier stages, describe how you would adjust to receive radiotelegraph signals through interference.

559. If broadcast signals interfered with your reception of signals on 500 kilocycles while aboard ship, how would you reduce or eliminate such interference?

560. How may a regenerative-type receiver be adjusted for maximum sensitivity?

561. What types of radio receivers do not respond to static interference?

562. Name three causes of an audio "howl" in a regenerative receiver.

563. Draw a circuit diagram of a crystal detector receiver and explain its principle of operation. Name two substances that can be used as the crystal in such a receiver.

564. Draw a simple schematic circuit diagram of an FM receiver discriminator.

565. If signals are heard with the headphones plugged into

the detector plate circuit of a receiver, but no signals are heard when phones are plugged into the first audio-frequency amplifier stage plate circuit, what might be the cause and how could it be remedied?

566. What is the purpose of an oscillator in a receiver operating on a frequency near the intermediate frequency of the receiver?

567. What is the purpose of a wave-trap in a radio receiver?

568. Draw a diagram showing a method of obtaining grid bias for a filament-type vacuum tube by use of resistance in the plate circuit of the tube.

569. Give four reasons which would prevent a regenerative receiver from oscillating.

570. Why are bypass condensers used across the cathode bias resistors of a radio-frequency amplifier?

571. What is the purpose of shielding between radio-frequency amplifier stages?

572. Draw a simple schematic diagram showing a method of "impedance" couplings between two stages of a radio-frequency amplifier.

573. Draw a simple schematic diagram showing a method of inductive or transformer coupling between two stages of a radio-frequency amplifier.

574. What is the purpose of an electrostatic shield?

575. What is the purpose of an auxiliary receiving antenna installed on a vessel which is also fitted with a direction finder?

576. How is "automatic volume control" accomplished in a receiver?

577. What is the purpose of a center-tap connection in a filament-supply transformer?

578. Draw a simple schematic diagram showing a method of coupling between two tetrode vacuum tubes in a tuned radio-frequency amplifier.

579. Draw a simple schematic diagram showing a method of coupling between two triode vacuum tubes in a tuned radio-frequency amplifier and a method of neutralizing to prevent oscillation.

580. Draw a simple schematic circuit of a regenerative detector.

581. What might be the cause of low sensitivity of a 3-circuit regenerative receiver?

582. What effects might be caused by a shorted grid condenser in a 3-circuit regenerative receiver?

583. Explain the purpose and operation of the first detector in a superheterodyne receiver.

584. Draw a diagram showing a method of obtaining grid bias for an indirectly heated cathode-type vacuum tube by use of resistance in the cathode circuit of the tube.

585. What is the advantage of using iron cores of special construction in radio-frequency transformers and inductances?

586. In the operation of a regenerative-type receiver how is oscillation of the detector indicated?

587. Draw a circuit diagram of a superheterodyne receiver with automatic volume control and explain the principle of operation.

588. To what frequency, or band of frequencies, is an approved auto-alarm receiver tuned?

589. What signal will cause an approved auto-alarm receiver to ring the warning bell?

590. What factor(s) determine the setting of the sensitivity control of an auto-alarm receiver approved for installation on a vessel of the United States?

591. On a vessel of the United States, equipped with an approved type of auto-alarm which employs a linear detector and an electronic selector, what factors cause the bell to sound? The warning light to operate?

592. With an auto alarm of the type which employs a square law detector and a mechanical selector, what factors cause the bell to sound? The warning light to operate?

593. With an auto alarm of the type which employs a linear detector and an electronic selector, what is the most probable cause of the intermittent ringing of the bells?

594. If you were a radio operator on a vessel of the United States, equipped with an approved type of auto alarm which employs a linear detector and an electronic selector, what would happen upon failure of a vacuum tube filament?

595. If an auto-alarm bell rings, and upon pressing the release button it stops, what could be the cause(s) of the ringing?

596. If an auto-alarm bell rings, and upon pressing the release button it does not stop, what could be the cause(s)?

597. With an auto alarm of the type which employs a square-law detector and a mechanical selector, why does this alarm receiver not respond to type A-1 emission?

598. If a vacuum-tube heater burns out, in an approved auto alarm, what causes the warning bells to ring?

599. Why are the unused portions of inductances in receivers sometimes shorted?